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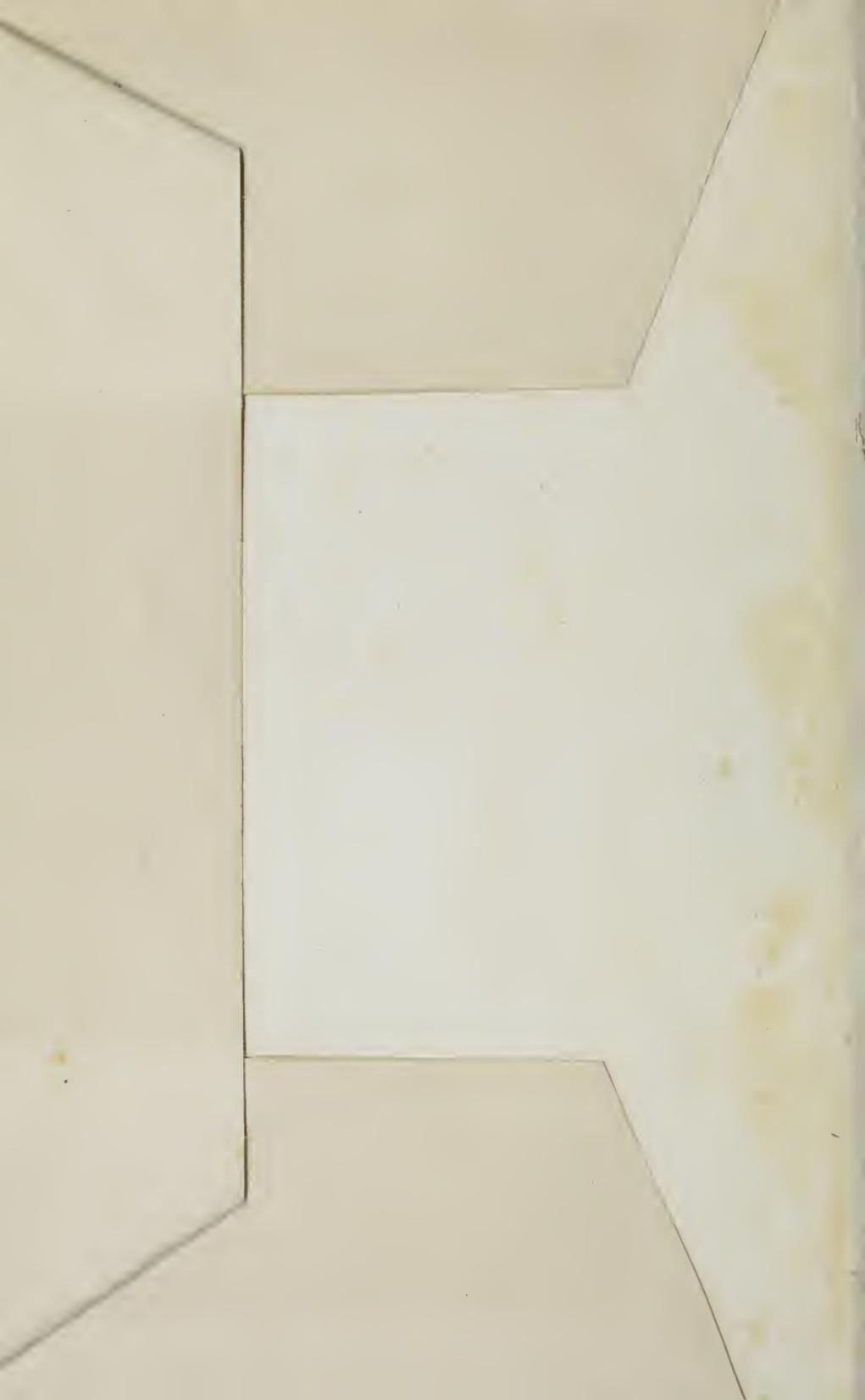
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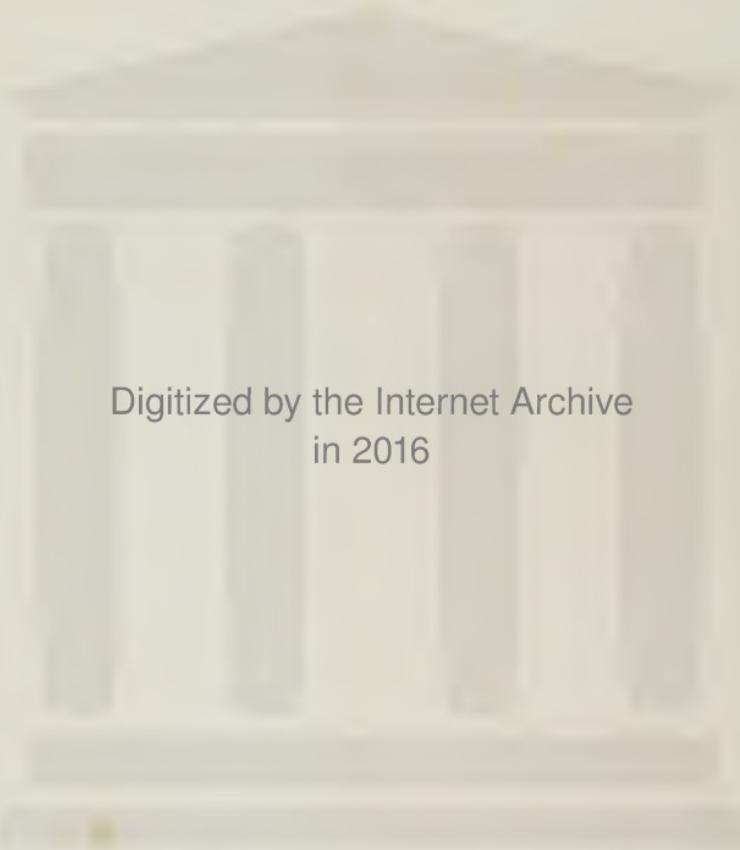




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Edward C. Stover  
474 W. STATE ST.  
Trenton, - N. J.



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# Photo- Ceramics.

*Photography applied to the decoration of Plaques,  
Pottery, and other Ceramic and Metallic surfaces.*

BY

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AND

H. SNOWDEN WARD.

*Both of the Staff of The Photogram.*

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DAWBARN AND WARD, LIMITED,  
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*T. Ward & Co., Ltd.  
Photo-Ceram.*



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## PREFACE.

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OUR publishers tell us this book ought to have a preface. We don't see the necessity; but there is one fact that we would like to firmly burn into the memory of every ceramic worker. As we cannot repeat it at the foot of every page, we give it prominence here:—

IN PHOTO-CERAMICS, DUST IS THE DEVIL.

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### A FEW WORDS OF ACKNOWLEDGMENT.

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We are happy to say that our efforts at popularizing the Photo-ceramic process have been well supported by our English friends. And here we wish particularly to acknowledge the invaluable assistance rendered by Joseph P. Emery, Grange Street Color Works, Cobridge, Staffs, who has helped us much by preparing special colors as well as in other ways. To E. J. Wall, editor of *The Amateur Photographer*, and Charles W. Gamble, of *The Photogram* staff, we also tender our thanks for their ready help. We also have to thank Hancock and Son, Diglis Color Works, Worcester, for various colors submitted for experiment, as well as for the illustrations of the various kinds of brushes inserted in this handbook.



# PHOTO-CERAMICS.

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## CHAPTER I.

### INTRODUCTION.

THAT the art of ceramic photography has received so little attention at the hands of professional photographers and the public in general is much to be regretted. With the exception of occasional magazine articles, and the publication of small trade pamphlets by firms interested in the sale of the necessary materials, little has been made known. The trade pamphlets have usually been sold at a ridiculously high price, as if the information given was, in fact, a divulgence of valuable trade secrets. The magazine articles have generally treated the subject as though taking for granted that the reader was already at least *partially* acquainted with the work. It seems to us that both these methods tend to enshroud the production of ceramic enamels in a cloud of mystery which, in turn, has almost confined their production to the hands of a few foreign firms, whose charges are so exorbitant as to not make it worth the while of a photographer to push their sale.

If photographers would cast off all thought of "mystery" and insuperable difficulties in connection with the process,

and prepare their own ceramic pictures—charging a reasonable price for them—we believe they would become both fashionable and popular.

As for the actual production of photo-ceramic enamels, the principal requisite is *care*; with care, cleanliness, and attention to details, success is certain.

We said just now that a certain veil of mystery surrounded the manufacture of these pictures. We had a glaring instance of this the last time we were in Canada. One of us was about to make some vitrified portraits of a certain size, and found that our stock of prepared tablets in that size was at a very low ebb. Wishing to avoid the delay consequent upon sending an order to Europe, we wrote to a friendly editor in New York asking him who dealt in such goods in the United States.

He went to much trouble in the matter, trying to procure some for us, but without success. In his letter on the subject, he wrote somewhat to this effect: "The whole process is kept in the hands of a few dealers as a mysterious secret; they will have the portraits made for you, if you wish it, but will not say where you can buy the enamel tablets. —, of this City, *could* give you the information if they *would*, but they will not give it to me." The result was we had to order the tablets from Germany.

It is not necessary in a small practical work of this description to go into the early history of the discovery and

progress of photo-ceramic enamels, nor shall we give a multitude of methods on the principle of "you pays your money and takes your choice." From personal experience, we believe such multiplicity of slightly varying formulæ (unless their variety of action is fully explained) tends to weary the practical worker.

The duty of the experimenter is to ascertain all the weak points of various formulæ and then give to the professional worker the benefit of his research—sparing him the necessity of making a long series of experiments for himself.

This is, we take it, what a practical man wants when he buys a book dealing with any special branch of his business. Broadly stated, photo-ceramic enamels are produced by two distinct methods—the "substitution process" and the "powder process." In the former process a collodion positive is stripped from its support, toned thoroughly with platinum, or gold, and other metals, and the remaining silver removed. It is then transferred to an enamel tablet, porcelain plaque, or other suitable material, and burnt in in the usual way.

The powder process is dependent upon the fact that a film of certain hygroscopic and gummy compounds, in conjunction with a bichromate salt, loses its power of absorbing moisture according to the degree it is affected by light passing to it through a transparency (used instead of a negative).

The parts most acted on by light thus lose their attractive power, while the parts protected from light still retain great affinity for moisture.

Directly they attract moisture from the atmosphere, their gummy nature causes them to hold any dry powdery substance brushed over their surface.

The print is dusted with a vitrifiable color until it is densely covered in the shadows; it is then coated with collodion and soaked in a bath to remove the bichromate salt.

The film of collodion is then stripped from its support, bringing the color with it, and transferred to the enamel plaque, and fired in a muffle furnace.

In the following chapters we intend to treat the reader as if he knew positively nothing whatever about the process except making a gelatino-bromide negative and transparency in the ordinary way. We shall assume he does not even know what a photo-ceramic enamel is, and we shall deal only with the necessary working details of the process. These we shall try to make as clear as possible in order to avoid confusion on the part of the student.

In a later and enlarged edition, now in preparation, we shall enter far more fully into the various ramifications of this most charming process, and shall publish many formulæ which we have hitherto reserved for more ample experiment and full verification.

The formulæ published in the present treatise are the result of many years' experience, and are the very best that we know for their various purposes. It is with confidence, therefore, that we urge the student to follow strictly the directions here set forth if he aims to attain proficiency in the art, with the least possible preliminary failure.



## CHAPTER II.

## WHAT IS A PHOTO-CERAMIC ENAMEL?

IN the form most generally seen, although at present very rare in Great Britain, these exquisite pictures are principally confined to small portraits.

They are, without doubt, the most imperishable form in which a photogram can be produced. Roughly speaking, the image itself is formed of a metallic oxide which is "burnt in" upon a surface of white enamel on metal, or upon china, delf, or glass. In the process of firing, which is done at intense heat in a muffle furnace, the image is covered with a protective coating of melted glass, which effectually secures it against the ravages of time and atmospheric change.

The small portraits (which are chiefly used as ornaments by the wealthy classes) possess a perfect glaze, which brings into prominence all the finest details of the photogram; the picture is usually made upon an enamelled copper tablet of convex form, and mounted in gold. Some of the very small ones are used in scarf pins and finger rings.

The possibilities of using such photograms as an extensive branch of decorative art have not yet been grasped

by manufacturers ; but it seems to us that they are letting a grand opportunity slip through their fingers.

It stands to reason that if photography can be applied to the decoration of bracelets (as, notably, those in possession of Her Majesty the Queen), it can equally well be applied to the decoration of china table-ware and household ornaments for the million. Why, then, does not somebody tackle the enormous possibility thus opened up ?

Everyone has seen the awful atrocities on china (supposed to be local views) which are produced by hundreds of thousands in Germany and sent to England to be sold as "A present from Mudbanks."

Everyone is equally well aware that such rubbish finds a ready sale, simply because there is nothing better to be had.

Considering that photography is equal to decorating china in far greater perfection than anything that can be done by hand or lithography, is it not pitiable to see the way our good British gold finds its way across the channel in the purchase of the rubbish we have mentioned ?

We bought a few years ago a very beautiful example of work by Geo. G. Rockwood, of New York. It is a child's portrait burnt in on a dessert plate, and richly decorated with gold and royal blue.

Such a practical application of photo-ceramics is to be commended, as also is the decoration of hearth tiles with scenes from our pleasant holiday haunts.

It is not our purpose to deal with such things in detail in this handbook; we only mention them in hope that the ideas offered will be turned to account.

We are aware (from experience) of the many difficulties hitherto existing in the way of anyone attempting to take up photo-ceramics. Not the least of these has been the difficulty of knowing exactly what materials were required, what their trade names were, and from whom they could be obtained. These difficulties we have tried to remove; we have hunted out makers of various materials and appliances and have interested a few firms sufficiently to induce them to undertake the stocking of all the materials necessary to the business, thus doing away with the necessity of buying colors from one house, fluxes from another, and plaques from a third, with the possibility of buying a mixture of various makers' goods that could hardly result in anything but subsequent failure on the part of a novice.

Furthermore, for the convenience of those who cannot afford to buy their own furnaces, we have induced one or two firms to undertake the firing of photographers' own enamels; and several will undertake the entire production of ceramic photographs from photographers' own negatives. Some firms confine this work to enamelled tablets and plaques, while others will vitrify photographs upon china-ware of all descriptions.

## CHAPTER III.

## MATERIALS.

It will tend to simplify matters somewhat if we give a list of apparatus and materials necessary for photo-ceramic work. We shall confine ourselves to as small a list as possible, leaving the treatment of more extensive appliances until the student has mastered the contents of this handbook.

The first and most important item is a furnace, and we strongly advise the student to buy one for his own use. Of course, he may possibly prefer to send his plaques to be fired, at least until he has some confidence in his ability; but sooner or later, if he wishes to conduct more advanced work, it will be necessary to have a furnace on the premises.

Where it is possible to secure a supply of gas, we strongly recommend the gas furnaces made by Fletcher, Russell and Co., of Warrington. We use their furnaces in our experimental work, and find them admirable.

They manufacture two kinds suitable for the purpose: one a muffle furnace (which can also be used for fusing and preparing colors) which is supplied in various sizes, and the other a tile painter's furnace, which is not provided with a muffle. The best furnace for small work is their "No. 461 muffle furnace," which admits a tile about three inches

wide by six inches long; this requires a  $\frac{5}{8}$  gas pipe and a supply of 60 feet of gas per hour. The price is £2 10s. There are several larger sizes, ranging in price to £6.

The "tile painters' furnace" will admit a tile twelve inches square (or a number of small ones); it requires a  $\frac{3}{4}$  gas supply pipe. The price is £4 10s.

We shall give illustrations of these furnaces in the chapter dealing with them, where we shall enter more particularly into the manner of fitting and using them.

Another muffle furnace, which is made to burn coke as a fuel, is manufactured by the Morgan Crucible Co., Battersea; it is especially useful where gas is unobtainable.

In America, several special furnaces are made for burning china ware, some of them being large enough to accommodate a small breakfast service at one firing. These are made for both gas and coke.

If the student decides to do his own firing, he will need (in addition to a furnace) two pairs of tongs (2s. each), gas tap and connections.

Fireclay.

Powdered chalk.

Wax tapers.

The following things are necessary for general use (say for  $\frac{1}{4}$  pl. and smaller):—

3 deep porcelain trays (9in. by 7in.)

1 4oz. graduate.

- 1 4in. glass funnel.
- 2 20-ounce bottles.
- 1 camel mop (No. 1).
- 1 3in. camel duster.
- 1 doz. thin patent plate glass ( $3\frac{1}{4}$ in. by  $4\frac{1}{4}$ in.).
- 2 test tubes.
- 1 packet filter papers (6in.)
- 1 silken sieve.
- 1 drying box or drying stove.
- Printing frames.
- 1 large white wash-hand basin.
- 1oz. best cotton wool.
- 1 photometer.
- 2 large camel-hair pencils.
- 1 badger blender.
- 1 glass slab and muller.
- 1 palette knife.

The materials required are as follows :—

Organifier.

Sensitizer.

Special collodion.

Vitrifiable colors (in powder) for painting.

Fat oil of turpentine.

Oil of turpentine.

Flux.

Enamel collodion.

## CHAPTER IV.

## THE TRANSPARENCY.

THE transparency must be as perfect as possible in every respect, and it must be remembered that the vitrifiable image will be an exact counterpart of it.

On this account it will be necessary to vignette, or mask, the negative exactly as it is desired to make the finished picture, as it is impracticable to do this when printing upon the bichromatized surface that is to receive the ceramic powder. The reason is obvious, but it may be well to repeat it here: all parts of the bichromatized film that are protected from light will have an affinity for powder, because the light has not been able to exert a hardening effect upon it. Hence, if we were to use a vignetter in the ordinary way (during printing) as if we were printing from a negative, we should produce an "Egyptian" vignette—that is, one with dark surroundings instead of light.

The transparency should possess plenty of pluck, with transparent high lights, and every bit of detail that is in the original negative; otherwise the vitrifiable image will be either weak and washed out, or harsh without detail. If small reproductions are wanted, they may either be made by

making a negative the size required by copying from a well-printed original and making a transparency from the negative by contact upon a lantern (or photo-mechanical) plate, or a reduced transparency may be made in the camera from the original negative. If the reader is well versed in copying, and can do it without producing a granular effect, the former is the easier plan, especially if a vignette is wanted. Vignettes may be made by the second method if a cardboard vignetter be swung to and fro between the negative and the lens during the whole exposure.

We strongly recommend the use of photo-mechanical dry plates for this purpose, unless the student understands the collodion process. It is desirable to have a transparency that is quite clear of fog in the high lights, with a full range of detail in the half-tones and shadows.



## CHAPTER V.

## THE SENSITIVE FILM, PRINTING, POWDER DEVELOPMENT.

THE solutions, known as the organifier and sensitizer, may be purchased ready prepared from the houses dealing in photo-ceramic goods, and for small businesses this will generally be found the best way to obtain them.

We give our formulæ for their preparation, and can vouch for their satisfactory results. Like all other formulæ in this book dealing with the dusting-on process, they are the result of personal experience, and have been carefully verified by experiment. Nothing has been given upon hearsay, nor have we taken anything for granted because someone else has said it was so. The student may therefore be convinced that if anything goes wrong it is not on account of the formulæ.

The sensitive film, upon which the powder image is to be formed, is prepared in two solutions, as follows :—

1. *Organifier.*

Dextrine . . .	3 drams
Honey . . .	4 ,,
Albumen . . .	6 ,,
Glucose . . .	1 ounce
Water to . . .	10 ounces

2. *Sensitizer.*

A cold saturated solution of Potassium Bichromate in water (about 1 oz. to 10 oz.).
--

For use : Mix equal parts of Nos. 1 and 2, and filter ; in their mixed state they will remain fit for use for about a week—a little longer in winter and less in summer. The solutions should be stored in a cool place, and must always be filtered just before use.

Our own formula, which is not only extremely simple, but gives excellent results, is composed of fish glue, glucose, glycerine, and water in the following proportions :—

<i>1. Organifier.</i>	<i>2. Sensitizer.</i>
Fish Glue (Le Page's) . . . 1 ounce	Ammonium Bi-chromate . . . 1 ounce
Glucose . . . 4 ounces	Water to . . . 10 ounces
Glycerine . . . 10 drops	
Water . . . 10 ounces	

For use take equal parts of Nos. 1 and 2, and filter. This mixture flows evenly, and dries with a brilliant gloss.

The method of preparing a plate is as follows :—Take a well-cleaned sheet of thin plate glass, and be sure that no dust adheres to it. Rapid polishing electrifies the glass and makes it attract particles of dust from the air ; it is, therefore, best to leave the plates for a few minutes after polishing, and then lightly dust them with a broad camel-hair duster to remove light adherent matter.

The plate must then be held by one corner (the lower left-hand one, usually) while a pool of the bichromatized solution is poured upon its centre. The plate is then tilted to

induce the solution to cover the entire surface of the plate, and the surplus is poured into a bottle kept for the purpose, so that it can be again filtered before use. The solution may be guided over the plate by means of a glass rod, or the tip of a finger, if it does not flow easily.

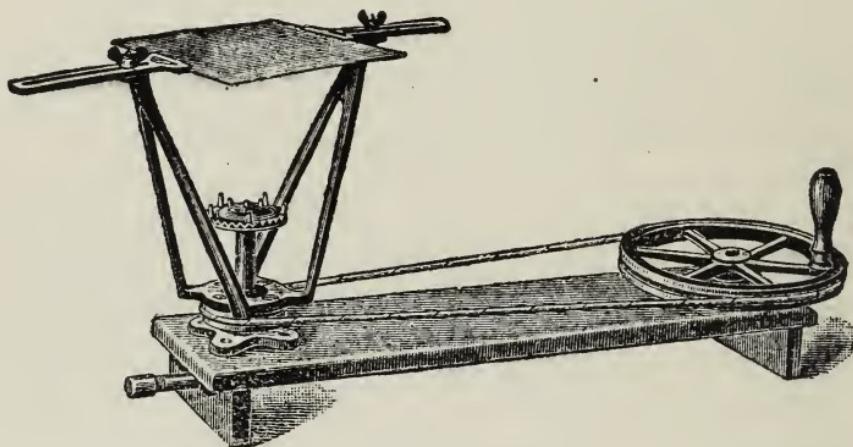


FIG. 1.

Large plates may be most readily coated by means of a whirler (supplied by Penrose for photo-mechanical work), which supports the plate above a gas jet, while the surplus solution is driven off by centrifugal force.

The plate may then be thoroughly drained, and either put away to dry in a drying-box (which is far the best plan if a number is being prepared), or held in front of a bright fire or over a spirit lamp until quite dry and warm. The film should be quite glossy when dry.

There need be no effort made to secure a thick film upon the plate; it is only necessary to have an even and thin coating, unbroken and free from dust. Any dust whatever,

if fixed in the film, will ruin the print. If such occurs it is best to wash the film away and recoat the plate. If dried before a fire the film should be ready for use in about two minutes; the plate must not be made hotter than can be comfortably borne upon the back of the hand. The surest way to avoid dust is to reserve a small apartment entirely for coating purposes. Each morning, before starting work, the floor should be well-sprinkled with water, and the air charged with an ounce or two of water by means of a vaporizer or spray diffuser—sold by druggists at about a shilling. This will carry down the floating dust, and in about an hour the room will be ready for use. Owing to the atmosphere being over-charged with moisture it will be necessary to develop the plates in another room.

In order to ensure the very best results we advise the student to warm the transparency just before use, then gently dust it with the camel-hair brush, and put it in the printing frame with the warm sensitive film in contact. The time of exposure varies somewhat according to the class of transparency. One tint of the photometer is usually about right—sometimes a little more, sometimes less—but a few trials will soon determine this point. When the student has made a few exposures he will rarely fail, no matter how often he changes the subject. The actual time of exposure will be from about one to three minutes in the sun, or from ten to twenty minutes in diffused light.

The image will be slightly visible on the film if the exposure has been correct.

Particular care must be taken to avoid exposing the sensitive film to daylight (except during printing), as, in its dry condition, it is extremely sensitive; very little light, improperly admitted, will often mar the beauty of the result by reducing the intensity of the deepest tones.

Development may be conducted in subdued white light in the following manner.

The worker should sit at a table in front of a window, the lower part of which is partially obscured with tissue paper, and the upper part entirely covered with an opaque blind or shutter. A sheet of white paper should be placed on the table in front of the worker, and the box of ceramic powder, a tuft of cotton wool, and the two camel "mops" should be within easy reach. If the atmosphere is humid it will be necessary to slightly warm the print upon removing it from the frame, before proceeding with the development or dusting-in; in dry weather there is no absolute need for this precaution, though personally we always adopt it.

The handiest method of holding the plate while dusting-in is to support the top edge upon the sheet of paper, holding the plate by the lower left-hand corner; the plate may thus be held at a convenient angle to judge of its progress, both by the light from the window reflected across its surface and that transmitted through it by the white paper.

The film side being upwards, we must form a smooth wad of cotton wool (say about an inch in diameter) and cover it plentifully with ceramic powder ; this must be applied with a circular motion over the entire surface of the plate. Plenty of powder must be used, and a continual series of small circles be described. On no account let the cotton wool rest in contact with the film, or trouble will be likely to

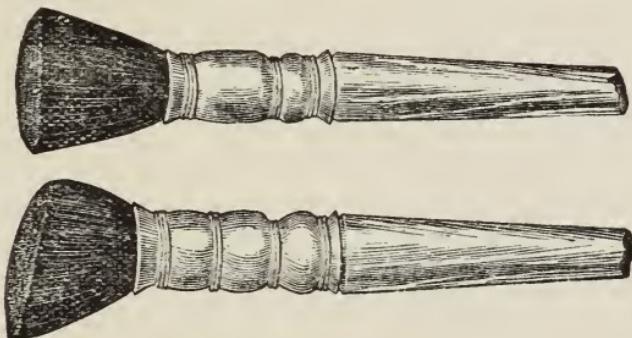


FIG. 2.—Mops or Dabbers.

ensue. The powder may be occasionally dusted lightly from the plate (by means of a mop) and the progress of the image more leisurely examined. If the finest details show distinctly when the plate is placed flat upon the paper, and if the density seems sufficient in the heaviest shades when examined between the window and the eyes, the development is probably complete. In this case all superfluous powder must be thoroughly removed—first with the mops, and finally with a large smooth pad of cotton wool applied with a circular motion. Considerable pressure may be exerted without causing damage. If any color still

adheres to the extreme high lights it may be removed thus: Heat the plate and then dust some flux on it, rubbing vigorously (with cotton wool) over the parts it is desired to free from color. Finally brush away the superfluous dust.

If development is not complete, and the image refuses to take more powder, the plate must be put away for a few minutes in a dark cupboard; it is sometimes desirable to hang a sheet of dampened blotting paper in the lower part of the cupboard while the plate is placed upon one of the upper shelves. In this way the plate is supplied with moisture sufficient to assist development without being near enough to cause damage. Such an aid is rarely necessary, except in cases of over-exposure, and then we should make a new plate rather than attempt to remedy an almost hopeless defect. Under normal conditions of correct exposure and average atmosphere, development should be complete in from one to four minutes. If the plate has been warmed after it is taken from the printing frame, this time will be materially increased.

If the powder sticks all over the plate and has a smearable appearance it is a sign of under-exposure. Over-exposure may be recognized by the plate refusing to take up the powder in sufficient quantity. A very dense transparency (used for printing) will require more exposure than a thin one, otherwise the resulting print (being much protected from the effect of light) will absorb too much color. A

very thin transparency must be exposed a very short time or the print will be affected by light to such an extent as to render it incapable of holding the color.

Failures—when one knows what to expect—are a valuable lesson; we therefore advise the student to expose a sensitized plate beneath a transparency for (say) one tint of the photometer; expose another for about half the time, and another for about twice or thrice the time under the same transparency. Then develop the three plates under the same conditions, and note the great difference in dust-holding capacity of each plate. Such an experiment will be a valuable object-lesson that the student is likely to remember, and by which he cannot fail to profit.



## CHAPTER VI.

## THE TRANSFER.

ACCURATE judgment is necessary in order to decide when development is complete. The appearance of the image will depend to some extent on the nature of the vitrifiable pigment that is being used. In some cases it is necessary to develop with more vigour than in others owing to the change of color that occurs during firing. With the majority of colors especially suitable for photographic purposes (such as the browns and reds of iron) we need not develop the image more densely than we wish it to appear after firing.

A good general rule is to occasionally hold the plate during development against a piece of white paper, from which is reflected plenty of light. The picture should possess about the same density as the transparency from which it is printed, or a first-class lantern slide. With this degree of density it will be certain to fire well and yield a well-modulated print.

As soon as development is complete the film must be

coated with plain collodion. The following formula is a good one :—

Sulphuric ether...	...	...	1 $\frac{1}{2}$ oz.
Alcohol ...	...	...	1 ,,
Soluble pyroxiline	...	...	7 grains
Castor oil	...	...	5 drops

or any reliable collodion, if specially prepared for photo-ceramic transfer, may be used. A very good collodion for the purpose has been submitted by J. W. Moore, Chemist, of Hanley, who prepared it according to our formula. For some time he had trouble in selecting a suitable cotton, but he has now overcome his difficulties and produces a collodion that is a great assistance in effecting the transfer of the film.

We have mentioned glibly enough that the film must be coated with collodion, but in all probability many who will read this book have never used collodion in their lives; we therefore give one or two hints on its application.

Hold the plate between the first finger and thumb of the left hand by the lower left-hand corner, taking care to hold it as nearly level as possible. Then pour a pool of collodion in the centre of the plate and incline it so that the liquid flows towards the top right-hand corner, then towards the top left corner, then towards the lower left corner (just missing the thumb), and finally pour off at the lower right-hand corner into another bottle. The collodion must be flowed quickly, yet without undue haste, otherwise it will set in streaks and ruin the transfer.

Directly the surplus has run off the plate the student will notice streaks and lines begin to form diagonally from the top left towards the bottom right-hand corner. These can be dissipated by deliberately rocking the plate *edgewise* from left to right and right to left. As the beauty of the transfer depends upon many trifling things, we advise the student to practise coating plain glass until he can do it properly with some degree of certainty. A few trials will achieve this. As soon as the surface of the plate appears uniformly even, the film is probably set; to make sure of this it is well to touch the bottom of it with the tip of a finger. If the film remains unbroken, it is sufficiently set to be put into the de-colorizing bath.

In all the foreign works on the subject we have found various chemicals suggested for the purpose of removing the yellowness of the bichromate, which, if allowed to remain, would irretrievably ruin the pureness of the result.

Among the many things suggested are sulphuric acid, nitric acid, hydrochloric acid, and caustic potash.

In very obstinate cases of discoloration the film may be immersed for fifteen minutes in a weak solution of sulphuric acid (say five *per cent.*), but it is *absolutely* necessary that all trace of acid be afterwards removed. It must also be borne in mind that acids have a deleterious effect upon many colors. In all our exhaustive experiments we have found the best bath for removing the bulk of the

bichromate to be pure water. The water should be filtered (although this is not *absolutely* necessary with the first two baths), and the plate must remain in it for at least fifteen minutes, and then removed to another tray of filtered water for a further fifteen minutes. The film must next be placed in a bath of fused borax solution (prepared as recommended for transfers), where it must remain about ten minutes. After immersion in a third bath of filtered water for ten minutes the film will be ready for transfer. Several films (as many as the trays will accommodate) may be washed at once, but there must be plenty of water in the baths, and it must be frequently changed.

The transfer must be effected in a basin, sufficiently large to accommodate the hands, filled with a solution of fused borax in the following proportions :—

Saturated solution (boiled) of fused borax	3 parts
Water	...   ...   ...   ...   ...   1 part

The mixture may be used several times, but must be filtered each time.

The fused borax is almost insoluble in cold water, so the best plan is to have a few ounces crushed to powder and boil it in a tin or enamelled saucepan with about a pint of water at a time. It should be boiled "at a gallop" for about five minutes and stirred all the time. Then pour off the solution and add more water, and repeat the operation until all is dissolved.

When cool, the surplus fused borax will deposit crystals in the bottle; these can be re-dissolved when required.

It is advisable to keep a plentiful supply of this solution on hand, as it is practically invaluable.

It serves several purposes; it not only discharges any remnants of bichromate that may be lurking in the film, but it binds the collodion firmly to the final support (after transfer) and prevents all inclination to blistering when submitted to the fire.

Before making the transfer, the edges of the collodion film must be released from the glass. It is best to do this with a sharp penknife pressed downward's directly through the film to the glass. On no account must the blade be *dragged* through the film, or the latter will pucker up and be rendered useless. A series of "stabs" through the film will soon free it from its support; the glass may then be placed in the basin of fused borax solution. The film will float from the glass (which may then be removed from the basin), and must be turned over so that the collodion side is downward, and the powder side (which was in contact with the glass) upward. The film may be easily turned by the help of a camel-hair brush about the size of a goose quill. Great care must be observed when touching the powder side of the film, or the color will be dislodged—if the film itself is not actually broken. We advise beginners to touch only the extreme edges while turning the film, and

on no account to touch the film with the fingers—or a disaster may be confidently expected.

As soon as the film is free, the plaque and a support (a small block of china or glass, to raise it off the bottom of the basin) may be put into the basin. If the basin is at all small, it is best to put in the plaque and its support *before* introducing the film and so avoid all risk.

When all is ready for the transfer, plunge the left hand into the solution and hold the support between the first and middle fingers, gradually raising the plaque.

Meantime, with the camel-hair pencil, manipulate the floating film until it occupies the correct position upon the plaque. The centre of the plaque may be raised slightly above the level of the liquid, but it must not be raised entirely from it until the film is in absolutely correct position. So long as the ends of the film remain in the solution, it may be moved freely, but directly they leave the solution they cleave to the lower side of the plaque and the transfer is complete.

If the film is wrinkled at all near the edges (although it is not likely to be), it may be gently drawn into position by lightly dragging the thumb downwards over the extreme edge of the plaque. Do not touch the top surface of the image, or the powder will come away and the transfer be rendered useless.

The plaque must be lifted from its support by means of a spatula and placed upon a few sheets of blotting paper until

dry. The ends of the film may then be removed from the back with a moistened rag, which will give it a clean and finished appearance.

If the transfer has been performed correctly, the image should now be in a similar position to that on the positive from which it was printed. Bear well in mind the fact that the powder must be *uppermost*—not in contact with the plaque. The collodion being in contact with the plaque will prevent the powder from chipping away when heat is applied. If the powder was nearest to the enamel plaque (*i.e.*, the collodion upwards) the collodion would peel away in innumerable fragments directly it was introduced into the furnace, and of course it would bring the color with it.

The powder side may be safely transferred in contact with the plaque if it is first immersed in the fused borax bath for ten minutes and then transferred to the plaque in the following solution :—

Water	...	...	...	...	...	80 oz.
Sugar candy	...	...	...	...	...	16 ,,

The syrup, acting as a cement, will fill up the minute air spaces present between the particles of powder, and firmly attach the film to the surface of the plaque; but it is then necessary to destroy the collodion film by means of sulphuric acid—a course not to be recommended. We always prefer to transfer the film, collodion side downwards, in the bath of fused borax.

## CHAPTER VII.

## FIRING.

HITHERTO all the operations have been purely photographic, and there has been very little need to employ much apparatus beyond what is already in the possession of most photographers.

It is just possible that some of our readers may wish to send away a few experimental tiles or plaques to be fired at the potteries before setting up a furnace for themselves.

Before entering into the subject of firing, we will, therefore, give a few brief instructions as to packing tiles and preserving the image from injury during transmission through the mails. The same remarks will apply to all classes of goods to which ceramic decoration is applicable.

In the first place, it is necessary to bind the loosely adhering color firmly to the support, otherwise a very slight abrasion will be enough to totally ruin the beauty of the result. By applying a suitable resinous substance to the surface, the powder becomes attached to the support after the manner of paint, and in this way is rendered less liable to accidental injury.

The preparation we use for this purpose is made by mixing

Fat essence of turpentine     ...     ...     2 parts.

Turpentine     ...     ...     ...     100     ,,

The solution must be well filtered and kept free from dust.

It is applied to the surface of the picture in the same manner as collodion (*i.e.*, by pouring); the surplus must be thoroughly drained away and the plaque or tile dried by gentle heat—say in front of a clear open fire or gas stove. When the medium has become dry by evaporation the surface of the image will be dull in appearance; if any shiny spots appear, it is a sign that the work is not sufficiently dry.

This preparation is very useful, not only for protecting the surface of the colors during transit, but for preventing the collodion film from blistering at the moment of introduction into the muffle.

The tile (if for transmission) must next be tightly wrapped in soft tissue paper; Japanese silk paper, or that known as “papier Joseph,” is especially suitable, being free from harshness.

It should next be wrapped in stout brown paper and finally covered with corrugated packing and tied with string. Always wrap *firmly*, so as to avoid all possibility of friction between the paper and its contents.

In this way tiles will travel in safety to any distance, and will bear rough handling with impunity.

For firing tiles, sheets of glass, and such like materials without sending them to a kiln, it is necessary to have a

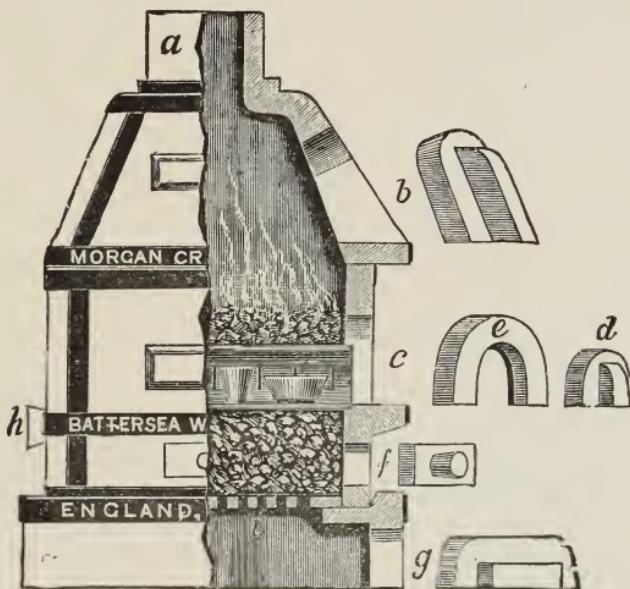


FIG. 3.—Portable Muffle Furnace for Coke Fuel.

special furnace for the purpose. A portable muffle furnace, for burning coke fuel, is made by the Morgan Crucible Co., of Battersea. Its construction will be understood from the diagram herewith (Fig. 3); the "muffle" is shown in Fig. 4.

Fire clay kilns can be constructed, in which coke fuel can be used; these are very useful in remote places where gas is unobtainable. Instructions in the method of building, as well as other useful information, will be found in various works dealing with pottery



FIG. 4.—A Muffle.

ware, as well as in "Glass-staining and Painting on Glass," published by Crosby, Lockwood, and Son.

We strongly prefer gas and advise its use wherever it can be had. The best gas furnace that we know of for this purpose is the one shown herewith (Fig. 5), which is made

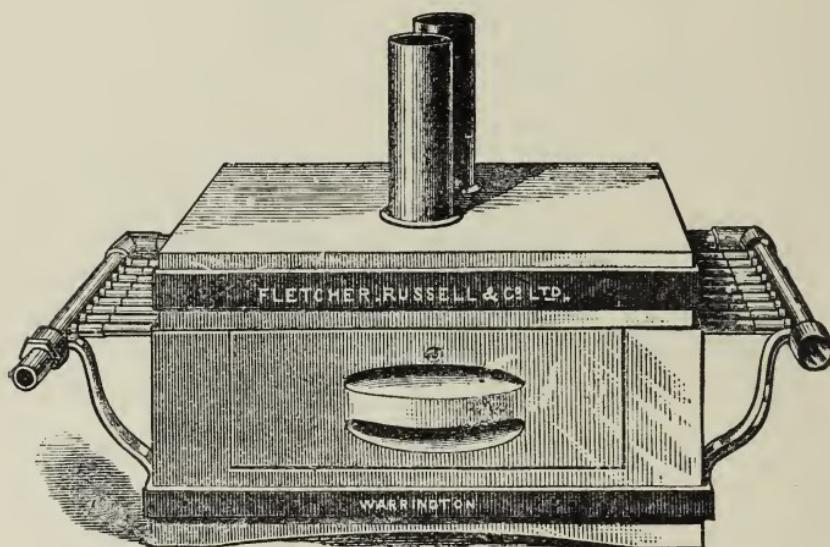


FIG. 5.—Tile Painter's Furnace.

by Fletcher, Russell, and Co., of Warrington. It is not provided with a muffle, but is thoroughly effective for its particular purpose.

Before turning on the gas see that a lighted taper is placed near the burners, so that the gas becomes ignited directly it reaches the jets.

Care must be taken that all the burners burn clear and blue. If any of them light at the jet the flame becomes smoky, and the air-hole under the burner must be closed for

an instant by a finger covered with a cloth (to prevent burns) until all are clear blue. In starting, the burners must be turned low at first and the heat gradually increased, to prevent cracking the tiles. The larger the tile the more slowly is it necessary to raise the heat. When a full heat is reached, turn the gas out at once, cover the chimneys, and allow the whole to stand untouched until cold.

In dealing with small tiles and opal glass, it is possible to avoid the long delay necessary before the kiln is sufficiently cold to be opened. In this case we must provide a hot closet, which may be made something after the style of a sheet iron oven. This should be provided with sliding shelves and supported over a gas heating ring to keep it at a good heat, and a quantity of coarse sand should be stored in the bottom compartment. When the glass or tile is fired it may be withdrawn (very carefully so as to avoid draughts), sprinkled with a little hot sand, and placed on one of the shelves in the hot closet, which is now to serve as an annealing oven. The oven should be kept close beside the furnace and the door must be closed, except at the moment of admitting work. When the oven is full, the gas may be turned out, and the box and its contents left until cold. On no account must it be cooled suddenly, or the contents will fly to pieces.

The firing of enamel plaques is much more easily conducted, because there is no necessity for extremely slow

cooling; in fact, an enamel may be cooled within five minutes without danger of the surface cracking. We recommend the use of a muffle furnace for firing photo-ceramic enamels. Those made by Fletcher, Russell and Co. are very convenient and cleanly, and can be made ready for



FIG. 6. External view of Furnace body, without Burner or Chimney.

use in ten minutes. The accompanying diagrams will serve to explain the appearance of the furnace. In Fig. 6 the actual furnace body is shown alone, without burners or chimney: this part is made in a solid piece of fire clay, bound about with iron bands. The two doors in front are also of fire clay, and are used to close the mouth of the "muffle," which is a sort of oven formed of thin fire clay exposed to the full power of the gas jets.

The other diagram (Fig. 7) gives a sectional view of the furnace, including burners and chimney; it also shows the interior of the muffle, which, it will be observed, is removable.

When about to use the furnace we usually "lute" the muffle in place, *i.e.*, fill up the junction between the furnace

mouth and the edge of the muffle with moist fire clay. This effectually prevents the escape of gas fumes, or the products of combustion, into the interior of the muffle. This is a necessary precaution when working with certain delicate colors.

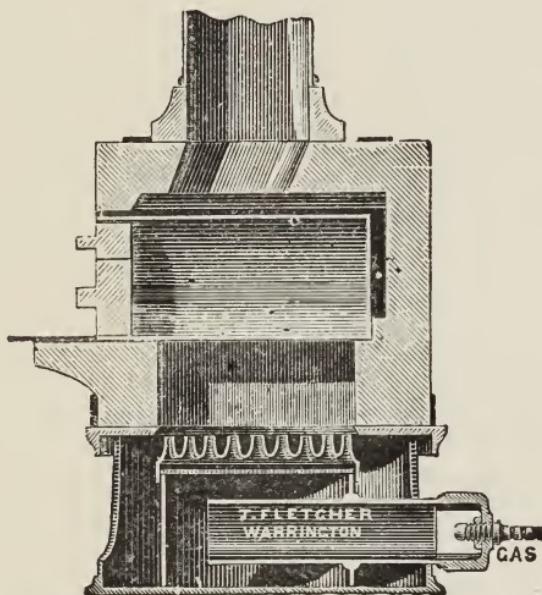


FIG. 7.—Muffle Furnace Section, showing internal arrangement.

We give a few general directions for the management of draught furnaces, similar to the foregoing, and it is necessary to bear them well in mind.

The gas supply tap and pipe must be large and clear, so as to give as great a pressure of gas as possible at the burner nozzle, although the actual consumption of gas is small. The india-rubber tubing used must of necessity be perfectly smooth inside. The tubing made on wire, whether the wire

is removed or not, *will not work these burners satisfactorily*. All muffle furnaces are sent out with a 2ft. 6in. chimney, having a cast-iron foot to enable it to stand steadily, and a short handle, by which it can be readily lifted with the crucible tongs. The gas supply specified is required to work each furnace at its full power, and the flame must be visible in the chimney. If the gas supply is deficient, the furnaces can be worked at a lower heat by partially closing the top of the chimney until the flame becomes visible, or by working without the chimney. If the burner plate becomes red hot it is a sign that the gas supply is deficient. The points of blue flame are always visible when the burner is looked into sideways, unless the gas supply is too small to work the furnace satisfactorily. To light the burner without removing the upper part of the furnace, put a lighted taper between the top plate of burner and underside of the furnace body, then turn the gas on slowly. If the furnace is hot it may be necessary to cover the air opening round the gas entrance to prevent the flame descending through the gauze at the moment of lighting. The burners can be easily taken apart, and must be kept clean. For photo-ceramic work, a chimney six or nine inches high will be ample.

Some workers have offered us serious advice regarding the danger of using gas furnaces. Others have declared they had tried to use them, and that they were incapable of generating sufficient heat in a reasonable time. Others

again have complained that sulphur fumes have found their way into the muffle and ruined the work.

We mention these facts lest a student be discouraged by similar remarks from people who do not understand the subject.

In the first place there is absolutely no danger if a gas furnace be handled with reasonable intelligence.

For instance: The correct way to start the furnace is to *first* place a lighted taper to the burner plate and *then slowly turn on the gas*. By this method the gas will ignite without the least noise. If an explosion is wanted, it is only necessary to turn on a full head of gas for about a couple of seconds, and then apply a lighted taper, to generate enough force to blow the operator on to his back (owing to the explosive mixture of gas and air collected beneath the muffle), but this is *the way not to do it*.

As for the gentleman who said it was impossible to generate heat—we need only say that, after being challenged by him, we practically demonstrated to him the absurdity of his contention by raising sufficient heat for enamel work within ten minutes.

The makers recommend a certain size of gas pipe, and this size (or larger) must be adopted. If a  $\frac{3}{4}$  inch pipe is necessary, it stands to reason that it is useless to expect to generate the requisite heat with a  $\frac{3}{8}$  supply.

As for sulphur fumes, these cannot enter the muffle if it

is properly luted into place, unless the muffle has been cracked by careless and too sudden heating. The mere fact of many ceramic color chemists employing gas furnaces to test their colors sufficiently disproves this.

Certain works have called attention to a similar muffle furnace (made by the same firm) which is provided with a "blast" in addition to the ordinary draught. No opinion has been given as to any increased utility accompanying the increase in expense over the ordinary draught pattern, hence the mere mention of them is liable to cause some doubt as to which is the better one; very likely people would be inclined to buy the more expensive "blast" furnace.

Let us set the student right in a few words; in the photo-enamel process we work at a red heat. This we can easily attain in the ordinary draught muffle furnace without a chimney. By adding a six-inch chimney we can secure this heat in a shorter time, and with a 2ft. 6in. chimney such as is usually supplied with the draught furnace, we can melt not only the enamel surface of a plaque, but the *copper base itself*, in the course of a few minutes. The blast furnace is used for melting steel, nickel, and similar metals, so that mentioning it as desirable for photo-ceramic purposes is absurd in the extreme.

It is best to use a low chimney (about six inches) with the furnace, and close the doors while the muffle is becoming heated. Do not turn on the gas to full power too suddenly,

or there is a danger of cracking the body of the furnace. When the muffle is almost red, a ring of fireclay must be put in and allowed to become thoroughly hot. On this may be placed a thin slab of fireclay (say  $\frac{1}{4}$  inch thick) which is to act as a support for the plaque. When the muffle appears of a dull cherry red (not a *bright* red) the slab may be withdrawn and the plaque placed upon its centre. It is then to be put within six inches of the entrance to the muffle and turned around, so that the film may be evenly roasted in the heat reflected from the interior of the muffle. If all goes well, the roasting will cause the film to change to a deep brown colour *without causing blisters*; at this point the plaque and its support may be advanced boldly into the hottest part of the muffle, and the doors must then be closed for about three minutes, during which time the surface of the plaque will become completely black. The heat must not be allowed to rise above a dull cherry red or the color will be *burnt*, which is a very different thing to being fired. In order to regulate the heat it is advisable to partially remove the top half of the door and peep into the muffle. If the heat is looking too bright lift the chimney off the furnace or lower the gas, but do not turn the gas so low as to turn the blue jets out of sight when looking sideways across the top of the burner plate.

The "Quadrant" tap, illustrated herewith, is excellent for securing regularity of gas supply day after day. It is the

one we always use, and have found it of great service; it should be placed quite near to the furnace, so that it can be operated with the right hand while a taper is applied to the burners with the left.

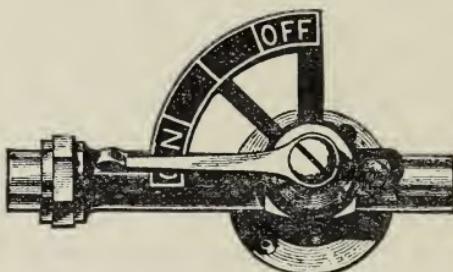


FIG. 8.—The “Quadrant” Tap.

At the end of about three minutes remove the top half of the door and turn the plaque and its support either with the tongs or a piece of thick iron wire suitably bent. If the picture has become clear again it is a sign that all organic matter has been burnt away and fusion is probably taking place. A good plan to ascertain this is to hold the wire hook above the plaque and note if a reflection is visible on the enamelled surface. If so, you may withdraw the plaque to the mouth of the muffle until the redness has died out of it; it may then be transferred (by passing a spatula beneath it) to a warm fire-brick, and left until cool enough to handle. The brick need simply have the chill off it; there is no need to make it red-hot, or anything like it. The plaque, while cooling, will assume many tints, that will probably cause pangs to pass through the frame of the student, but it will finally assume its proper color.

If the plaque possesses a perfect glaze—quite brilliant alike in the highest light and deepest shade—and an even color, it will not require further firing; but this is hardly likely to happen with a first attempt. In all probability the plaque will either be underfired, unevenly fired, overfired, or burnt.

Underfiring may be recognized by a general dull appearance which pervades the heaviest deposit of color; the remedy is to fire again for a few minutes. Uneven firing is due to neglecting to turn the plaque so that each part has a fair share of the heat; this will be noticed by the patchy appearance of the color, some of which is vitrified and some not. This fault cannot be remedied satisfactorily by re-firing. Overfiring gives a woolly, sunken-in appearance to the image, due to its having sunk too far beneath the surface of the glaze;—no remedy.

A brilliant red heat is liable to “burn” a color and deprive it of all its beauty, giving it instead a dirty tinge-like nothing else that we can describe. In order to avoid the frequent occurrence of such a disaster, we advise the student to make himself thoroughly acquainted with the appearance of the muffle at its correct heat.

About the best plan to follow is one suggested by Joseph P. Emery, of Cobridge, who has given us valuable assistance in this particular. He advises the use of the “Rose-color test.”

In all large china-painting establishments the efforts of the firemen are directed towards keeping the temperature of their regular kilns at what is generally known as "rose-color" heat. This does not imply that the color of the kiln must be a rose red, but it indicates the exactly correct heat at which rose color vitrifies and assumes its true tint. Rose color has been generally adopted for this purpose because its change of tint, due to varying temperature, is more easily marked than that of any other color.

At a low, easy heat the color assumes its correct tint, but without thoroughly glazing; at the heat known as "regular kiln" (for which all colors sold as "regular kiln" are adapted) the color retains its true tint and becomes glazed; at an excessive heat the color assumes a peculiar bluish cast, which is unmistakable. If noticed in time, and the heat promptly reduced, the other colors (being less sensitive to slight fluctuation of heat) may be saved from burning.

It is advisable to mix a little "Rose-color, No. 20," with lavender oil and apply some of the mixture to a few bits of china and put them in the muffle at the same time as the object that is being fired. By occasionally withdrawing a trial piece and examining its color and glaze a correct idea of the heat may be gained.

But before attempting firing in dead earnest we strongly urge the student to paint a number of pieces of pot or opal glass partly with rose-color and partly with the color he

intends to use in his photographic work. Then heat the muffle to what is judged to be a dull cherry red in appearance and introduce the trial pieces at various intervals, withdrawing them when they appear to be glazed. In this way, by steady practice, a far better actual knowledge of the effect of varying degrees of heat may be gained than by any other method.

We advise the student to procure two "test tiles" bearing the "Rose-color test" and the color he intends to use, fired at "regular" and "hard" kiln heat. These can be obtained at a nominal cost from the firms supplying the ceramic materials and colors. Once having a standard test, such as we have indicated, the student can make correct comparison at any time.



## CHAPTER VIII.

### CONCERNING COLORS, PLAQUES, AND EARTHENWARE.

WE advise beginners to purchase their materials as far as possible from one firm—especially as regards colors and china, tiles, or earthenware—as dealers who understand the requirements of the process will be careful to adapt the colors and other materials to each other, and so eliminate one great cause of failure.

A very complete “Beginner’s Set” of colors and other materials is put up by J. W. Moore, 10, Tontine Square Hanley, Staffs, who has submitted samples for trial.

We find he has carefully prepared the materials according to our published formulæ, and in our hands they yield excellent results.

We understand Messrs. Hancock and Son, Diglis Color Works, Worcester, intend stocking all requisites for the process, but cannot say if they intend putting up small complete trial sets.

The various samples of colors submitted by them included several specially suitable for photographic purposes; we also found their prepared oils very useful for laying

grounds and other purposes where hand-work is employed, as will be mentioned elsewhere. No doubt other firms will follow the lead as soon as they realize that there is a demand for materials.

Hitherto we have not suggested a cheap material for using in experimental firings at home. Superfine enamelled copper plaques are much too expensive for anything but the finest work, but a "seconds" (made by Charles Garnier, 86, Farringdon Street, London, E.C.) will be obtainable of most dealers in photo-ceramic materials by the time this handbook appears.

These will be sold at a few pence (instead of shillings), and will be extremely useful for gaining an accurate knowledge of firing enamelled copper plaques.

Opal glass is a very cheap and useful material for firing trial blends of colors, and for similar purposes, although it behaves somewhat differently from the enamelled plaques. We advise the use of opal glass for simply trying new colors and blends, but if the student intends to fire his own copper plaques he should certainly make a few trial firings upon the "seconds" quality.

In all the articles we have read bearing upon this subject, we notice the writers urge the necessity of very gradually raising the heat when firing opal glass. This holds good when dealing with large sheets (as with all other descriptions of glass) and special precautions have to be taken to

avoid warping of the glass, but with small pieces we find the method is a distinct disadvantage.

It renders it impossible to conduct numerous firings, because of the long time necessary to cool the furnace after each batch.

In the course of our experiments we found it necessary to fire several hundreds of small opal glass tablets in the course of a day, which would have been impossible with the very gradual heating necessary when firing large sheets of glass. We tried a moderate heating; that is, we placed the glass upon a slab of fire-clay (coated with a thin layer of chalk to prevent adhesion), and inserted it in the muffle before lighting the gas. Then we started the fire and allowed about fifteen minutes for the muffle to become fully heated. In about ten minutes—and in some cases even after the glass was at a dull red heat—the opal flew into a number of pieces. This happened several times, yet we knew we were devoting far more time to gradual heating than we could spare, so after various trials we hit upon the plan we have since adopted for small experimental work, which rarely results in fracture.

We heat the muffle and a block of fire-clay to a dull red heat, and place the opal glass upon the top of the furnace, near the chimney, to become hot. When the fire-clay is red-hot we withdraw it, drop the opal glass upon it, and immediately introduce it to the full heat of the muffle, and

close the door. In a few minutes (two or three) we withdraw the glass and lean it against a block of wood, or fire-clay, in such a position that the air can have free access to it. In this way it quickly becomes cool and rarely cracks. If we wish to preserve it, we anneal it by putting it into a box of very hot sand directly the melted surface of the glass has become set—say, in ten seconds after removal from the muffle.

This will be found a very useful plan for trial firings, but, of course, when firing large sheets of glass special precautions must be taken; large sheets must be fired in a tile painters' furnace. (Fig. 5, page 34).

The blending of colors will be found a very interesting field for experiment. For instance, when working with "Emery's purple brown No. 5," the student will find the appearance of the color different when fired upon earthenware in the ordinary kiln from the same material fired upon opal glass or copper plaques in the muffle furnace at home. In the former case the color (which is a dull red before firing) turns to a charming shade of brown, due to the thorough vitrification caused by long firing at "regular" heat—the true conditions for which the color is prepared. The same color upon opal glass, or a copper plaque, fired in the muffle furnace at home, comes out of the fire with a tint very nearly approaching Bartolozzi red. This is due to the soft material, of which the glass is composed, melting

rapidly at a low heat; thus the color becomes absorbed by the glaze before it has had time to become true to tint. In order to modify this when working upon opal glass, or enamel, we may add "Emery's jet No. 263" in any proportion—making trial firings until the desired color is reached. We do not advise this addition when the photo-ceramic transfers are to be fired at the potteries, as the result is then not so pleasing as the single color—whether that be brown or black.

It is necessary to *thoroughly* incorporate the colors when mixing them; the proper way to set about this is to grind them together upon a glass slab with a muller. During the grinding they must be moistened with water until the muller works freely. About ten minutes' grinding will suffice; the color must then be dried in a place free from dust, for in this work

#### DUST IS THE DEVIL.

Although most colors, as received from the dealer, are in a state of fine powder, still it is advisable to take the precaution of grinding them again (with water) for about ten minutes—doing only about a dram at a time. After thorough drying, they must be passed through a fine silken sieve such as is supplied for the purpose.

Ceramic colors that are prepared for regular kiln will not give decent photographic results upon china unless it has been previously prepared for the purpose.

We are quite aware that they will do so when used as *paints*, but after the completion of the photographic transfer the color is not in its normal condition.

In its normal condition, the coloring matter is combined with a "flux," which melts at the temperature of the regular kiln and combines with the color, binding it to the china.

The glaze upon china is due to a flux which melts only at a much higher temperature (hard kiln).

The surface of opal glass and enamelled copper plaques melts at the temperature of regular kiln.

Therefore if we use a ceramic colour in its normal condition as a paint, upon any of these materials, it becomes fixed to their surfaces by virtue of the soft flux contained in itself.

The photographic operations, and the many washings, tend to deprive the color of a certain proportion of its flux so that it is not capable of fixing itself to a "hard" glazed surface. The consequence is, if we attempt to fire a transfer upon ordinary china, the color will not attach itself at "regular" heat, but will remain in the form of an easily removable powder. At hard-kiln heat, the original glaze of the china would become tacky and hold the color, but the excessive heat would have destroyed its tint.

The result is different upon opal glass, enamel, or soft-glazed earthenware, which melts much more easily; at

regular heat the surface softens and holds the color, giving it a finished and glazed appearance.

In order to work upon china, it is therefore necessary to prepare its surface by "ground laying" it with a soft flux, which is done (or is about to be done by some firms) especially for photographic purposes.

We shall deal with the method of doing this in the next chapter, but we think we have made clear to the student why it is advisable to procure materials that are specially prepared for the purpose.

The student should be content to buy his colors from a reliable dealer, and should not attempt their manufacture until he is at least thoroughly conversant with their use and composition. The preparation of enamel colors generally necessitates the thorough fusing of the ingredients in a crucible, which is a somewhat irksome job, but the following easily compounded black pigment may be used if the student is situated far from dealers in vitrifiable colors.

We must first prepare a flux as follows :—

Silica	...	...	...	...	1 part
Minium	...	...	...	...	8 parts
Borax	...	...	...	...	2 ,,

or

Silica	...	...	...	...	3 parts
Minium	...	...	...	...	6 ,,
Borax	...	...	...	...	3 ,,
Saltpetre	...	...	...	...	1 part

The ingredients must be thoroughly mixed and fused together in a crucible at a quick heat, well stirred with an iron rod, and then spread upon metal plates to cool; it is then pulverized and sifted.

The black color may be composed of

Black oxide of iron ... ... ... 1 part

Flux ... ... ... ... 2 to 3 parts

or, to our mind, a still richer black may be made by mixing

Red or bright violet oxide of iron ... 1 part

Flux ... ... ... ... 2 to 3 parts

which gives by reflected light a rich reddish-violet black which is very agreeable.

As the majority of readers will be able to buy their colors ready prepared, and of far better quality than they can hope to make for themselves, we shall not enter extensively into the question of color manufacture in the present handbook. With the following formula for the preparation of a white enamel we shall leave the subject:—

Arsenic... ... ... ... 1 part

Saltpetre ... ... ... ... 1 ,,

Silica ... ... ... ... 3 parts

Litharge ... ... ... ... 6 ,,

Fuse together in a crucible, and as soon as the enamel has ceased to bubble and appears to be in a liquid state pour on to metal plates to cool. Then grind to a coarse powder for use.

## CHAPTER IX.

### GROUND LAYING — GLAZING — RETOUCHING — RECOVERING WASTE PLAQUES.

In the last chapter we referred to the necessity of "ground-laying" hard glazed china and earthenware before attempting to fire photo-ceramic transfers upon them. It sometimes may happen that it is necessary to do this for one's self, and, in order to be prepared for such an emergency, it is well to keep a supply of soft flux on hand. Any reliable easily fusible flux may be used, such as Hancock's, Harrison's, or Emery's No. 8.

There are several ways of applying it. For instance, take a quantity of flux and grind it with a little oil of turpentine and a small proportion of fat essence\* (about two per cent.). Mix it to the consistency of paint and apply it either over the whole of the tile (or other article) or only to the portion to be decorated. The flux must be applied in a thin and extremely even coating; otherwise it is best to remove it and lay the coating again. The final strokes may

\* "Fat essence" is oil of turpentine or any essential oil that has been exposed to the continued action of light and air until it has become of a fatty consistency, due to evaporation. It is added to give body to the oil.

be given with a badger or camel-hair softener (Figs. 9 & 10), and it should be applied with a very light touch. It is sometimes beneficial to breathe on the work while laying a glaze;

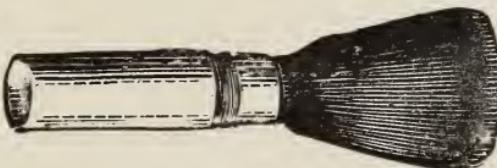


FIG. 9.—Badger Softener.

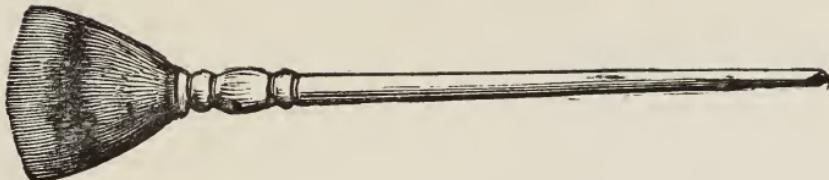


FIG. 10.—Camel-hair Softener.

the moisture of the breath helps the coating to assume a perfectly smooth and even surface. Extreme care must be taken to guard against dust settling on the work, for in this work DUST IS THE DEVIL.

Another method, useful for large surfaces, is to thinly coat the ware with a mixture of equal parts of thick lithographic varnish and turpentine painted on with a brush, and, when partly dry, lightly dabbed with a pad of cotton wool enclosed in chamois skin or silk. The flux is then shaken on through a silken sieve and allowed to dry, when the surplus is dusted off with a camel-hair mop.

In both these methods it is somewhat difficult to judge of the evenness of the coating owing to the flux being almost

devoid of color. In order to overcome this difficulty we advise the student to add to the flux an amount of lamp-black sufficient to give it a gray tint. The coloring matter will be consumed in the muffle and will leave no trace behind.

In print we are often recommended to apply a glaze to photo-ceramic transfers after firing, and we have carefully tried all the various plans recommended.

The result is that we strongly condemn the advice as bad, and generally worse than useless.

If the ware possesses a suitable surface the transfer will naturally possess a brilliant glaze if properly fired; if the original glaze of the ware is too hard, it must be laid with a glaze (and fired) *before* the transfer is placed upon it. It will then be provided with a brilliant glaze after firing. But if a transfer be fired upon a hard and unsuitable glaze, it will neither fasten to the ware nor have a brilliant



Banding brushes—sometimes used. (Nos. 5 and 6 answer the same purpose after a little practice.)

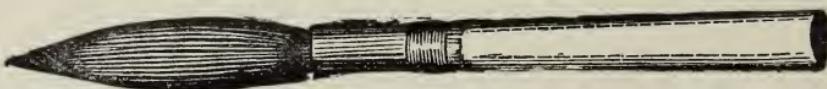


FIG. 11.—Brushes for China Painting.

surface, as we have already fully explained. If the student wishes to try laying a glaze on such an object he can proceed by either of the plans recommended for ground-laying, but he will find the majority of cases yield very disappointing results, full of imperfections.

A very pretty effect can be obtained by ground-laying the whole of a tile, plaque, or other ware with a delicate turquoise, cream, pearl grey, or other shade such as is supplied for the purpose by all the color merchants we have mentioned. After laying the ground, but before firing, parts may be removed by means of a rag stretched over a piece of wood pointed like a chisel. If these parts are removed from the places to be occupied by principal high lights—such as face and hands if a portrait, or the sunny parts of a landscape—a charming effect may be obtained. Of course the ware must be fired before applying the photographic transfer. We simply give the suggestion and leave our readers to follow it out and amplify it.

After firing a transfer upon enamel, china, or other ware, it sometimes requires retouching. If all the operations have been carefully carried out, the picture should be almost perfect, but still may require a little after treatment.

The most common fault will be a slight discoloration of the high lights on the draperies, due to color adhering

where it was not wanted. Such patches may be readily removed with a mixture of

Hydrofluoric acid	...	...	...	1 part
Water	...	...	...	20 parts

contained in a rubber or leaden vessel. Apply it with a camel-hair brush, touching the parts very quickly, and then, *immediately*, allowing water to wash the solution away.

This may be done as often as necessary until the highlights are brilliant and well-defined. Small dark specks may be touched with a little stronger mixture applied with the point of a sharpened stick and immediately washed away.

White specks, due to dust, may be filled with color (mixed with turpentine or oil of lavender and fat essence) applied with a spotting brush. When dry the enamel may

be refired to fix the spotting, but, as far as possible, it is best



FIG. 12.—Small Finisher.

to do the retouching previous to

firing. Specks are then easily removed by lifting them with a fine needle point, and white spots are filled with color mixed with oil.

We must caution beginners to be extremely careful in working with hydrofluoric acid, which is very corrosive in its action. The acid has to be stored in gutta percha bottles (as it would eat its way through glass in a few minutes), and, even when much diluted, it causes very painful sores if

allowed to come in contact with the base of the finger nails. The fumes of the strong acid are also extremely injurious. We invariably protect our fingers with rubber gloves or finger stalls when working with it—a very necessary precaution.

The acid, diluted in the proportions we have named—in some obstinate cases a little stronger, say 10 per cent.—is useful for recovering waste plaques which have been spoilt in firing.

Take a few ounces of the dilute acid in a leaden or rubber tray and immerse the plaque. Hold it firmly down to the bottom of the tray with the fingers of the left hand, and rub it briskly with a rag rolled on the end of a piece of wood. When the image has disappeared, wash the plaque, dry it, and fire for about a minute in the muffle, which will restore its glaze. It will then be once more ready for use.

NOTE.—If the student wishes to become proficient in groundlaying and decorating china by hand, he will find much valuable information in “The Amateur Pottery and Glass Painter,” published by Hancock & Son, Worcester.



## CHAPTER X.

COMBINATION PRINTING—PHOTO-CHROMATIC (THREE-COLOR)  
PRINTING—PHOTO-DIAPHANO-CHROMOGRAMS.

COMBINATION printing may be very effectively employed in photo-ceramics. For instance, an entire ground may be laid in a light tint (say a grey or fawn) by means of a special transparency, in which all of the plate, save a few extreme high lights, has been blocked out with an opaque pigment. This tint, when transferred to china or enamel, must be burnt in, when the plate will be ready for a transfer printed from the original transparency in any dark color suited to the subject.

The transfer must be carefully registered over the tint and then fired, when the resulting picture will be very effective. In this way a portrait may be produced in black or brown upon a fawn (or other tinted) base, with the points of high light—such as pearl ornaments or tips of light upon light drapery—well illuminated. We need hardly make more than the bare suggestion, although there are many ways in which the suggestion may be utilized; these will occur to any attentive worker.

A more advanced combination printing, likely to prove extremely effective, is based upon the photo-chromatic methods of three-color printing which have been so thoroughly dealt with (in relation to the preparation of photo-engraved blocks) in *The Process Photogram* and elsewhere.

Briefly the method consists of printing from three negatives of colored objects, taken through special screens, which exclude certain colors from each.

The portions of developable image upon these negatives represent all the blue rays upon one, all the red rays upon another, and all the yellow rays upon the third. No matter how the colors may be blended in nature, the three separate plates secure every gradation, so that when the images are placed one over the other the resulting combined picture is a *fac-simile* of the coloured original.

In applying this method to photo-ceramics there is no necessity for employing a "grating" (or ruled plate) as in photo-engraving, hence the results can be made infinitely more beautiful.

The films must be printed (each in its proper color) one at a time, and lightly fired after each transfer. The firing need only be sufficient to fix the image to the plate without a finished glaze.

To facilitate registration of the three transfers it is advisable to mark the plates each with two small crosses, or if the original is a painting similar marks may be made in

black upon it; these will then be photographically impressed upon each plate.

The coloured transfers must be super-imposed in the following order :—1st, yellow; 2nd, red; 3rd, blue.

Hitherto our chief difficulty has been in finding a blue vitrifiable pigment thoroughly suitable to this process. We have not, at the time of writing, secured such a powder that has combined the correct color with transparency and the power of adhering sufficiently to the gummy plate. This is, however, merely a matter for further experiment, and we expect to soon surmount the difficulty.

There is another principle which has been much abused in connection with photography and process-mongers, but which is capable of yielding exquisite results in photo-ceramic work. We refer to what is popularly termed “the coloring-behind dodge.”

The method is extremely simple, but care is necessary to secure correct registration.

To produce a photo-diaphano-chromogram a transfer must first be made in a light warm colour, and fired upon the china or plaque. This will give all the true outlines, which must then be roughly tinted a little deeper than is desired in the finished result. No attention need be paid to light and shade so long as the high lights are carefully preserved from too much color. Extreme points of light must be left entirely free from color. The face may be

roughly tinted, adding a little brighter color on the cheeks and lips; blending may be done either with a very small mop or with the tip of a finger.

Until the worker is thoroughly used to enamel colors and their peculiarities, we advise him to give this work to a china painter, who will do such rough and ready painting at a low price.

When the painting is complete it must be fired, and then the final transfer (which is to supply all the gradations of light and shade) may be made at leisure.

A good color for preparing the first transfer may be made thus :—

Dissolve Pure sulphate of iron	...	1 part
In hot water	...	10 parts

In a separate vessel dissolve

Potassium bichromate	...	1 part
In hot water	...	10 parts

Filter the solutions and mix them together, stirring with a strip of glass. A precipitate will form, and must be allowed to settle for about two days, when the clear solution must be decanted and thrown away.

The precipitate (chromate of iron) must next be thoroughly dried in an oven or crucible, when it may be mixed with flux in the following proportions :—

Chromate of iron	...	...	1 part
Flux	...	...	3 parts

The ingredients must be ground together with water and dried. The color is then ready for use. The best color to employ in making the second transfer is a rich dark brown.



## CHAPTER XI.

POSSIBLE APPLICATIONS TO JEWELLERY AND DECORATIVE ART—  
HOW TO MAKE ENAMELLED COPPER PLAQUES.

PHOTO-CERAMICS may be applied in innumerable ways to the decoration of jewellery, matchboxes, cuff links, souvenir spoons, drinking cups, salad bowls, serviette rings, etc. Many such applications will suggest themselves, and we expect it will not be long before articles are manufactured especially for such enamel decoration.

Robert Pringle and Co., of Clerkenwell Road, E.C., have already expressed their intention of preparing brooch mounts, electro-plated frames for converting photo-ceramic tiles into teapot stands and various similar goods that are bound to become popular if photographers will only approach the subject with determination to cater for the public, and keep this work in their own hands while they have the chance.

Unfortunately they closed their eyes to the fact that photo-engraving was bound to grow in popular favour, and, as a consequence, that work is now controlled by a distinct class.

We have tried to simplify the photo-ceramic process by pointing out an exact course to follow, and we can only trust that photographers will grasp its possibilities without further

delay, and not let this lucrative application of photography drift from them into the hands of others.

Even in the preparation of enamelled copper plaques there is a capital opening for an energetic man.

At the time of writing we only know of one firm in England (Penrose & Co.) making plaques of the best quality such as are made in France. Second quality plaques (suitable for experimental purposes) are plentiful enough, but it is almost impossible to buy the best quality.

One member of a firm of photo-ceramic enamellers informed us quite recently that he had been unable to obtain any supply from the French house with whom he dealt although six weeks had elapsed since his last order was sent. In consequence of this the firm's enamel work was all at a standstill.

While upon this subject we cannot do better than quote freely from an excellent report of a practical demonstration of the preparation of enamelled plaques, given by Mr A. Haddon before the London and Provincial Photographic Association.

The full report, from which we make the following extract with accompanying diagrams, appeared in *Photography* of Oct. 5 and 12, 1893, and was written by W. H. Harrison:—

“Enamel is sometimes sold in thin slabs cast on sand; these cakes then have to be broken up and powdered with a steel pestle in a wooden mortar, then sifted, then powdered

again, until it all passes through the sieve. In the case of the bought powder, it first has to be soaked during from three to twelve hours in a twenty-five per cent. mixture of nitric acid and water to dissolve all metallic particles, and to carry off organic matter; the weak acid is then poured off and tap water poured on. The coarser particles of enamel are separated from the finer particles by means of suspension in water, just as the glass grinder separates his emery powder into different degrees of fineness, except that in the separation of purchased enamel it is wanted but in two degrees. An ounce of the enamel powder may be stirred up in a large tumbler of water, allowed to stand for one or two seconds, and then the milky liquid containing the finer particles in suspension be poured off into another glass. The coarser particles which sank to the bottom in the first glass may then be stirred up with more water, to separate more of the finer particles for pouring off, and so on four or five times in succession. At the end of these washing operations the coarser particles are at the bottom of one glass, and the finer particles of different sizes are partly in suspension and partly at the bottom of the other glass of water, which has to be left for a few hours until most of the fine enamel has settled down. It should then be washed again a few times to get rid of all acid.

"The thickness of the copper used, as a support for the enamel, must depend upon the size of the plaque; he used

a thickness varying from  $\frac{4}{1000}$  of an inch (for a plaque measuring about  $\frac{3}{4} \times \frac{5}{8}$  inch) to  $\frac{12}{1000}$  of an inch. The latter was thick enough for carte-de-visite size.

"The copper foil has next to be annealed;\* it has to be raised to a red heat, and then to be cooled suddenly, not slowly. Pure copper is almost as soft as lead, and can easily be bent, twisted, or cut into any shape. After annealing it has to be cleaned by being rubbed over with a one per cent. solution of nitric acid by means of a nail-brush, and then rubbed down with powdered flagstone; after this it has to be thoroughly washed, so that it presents a surface of pure metallic copper. Next it has to be brought into shape, and this is done by the aid of a circular or oval plate of zinc or brass with a bevelled edge, cut by a turner, as in Fig. 13.

---

FIG. 13.

"The next step is to cut out an oval piece of copper a little larger than the zinc plate; this is done by placing the plate on the copper foil and making a mark round it on the copper by means of a slightly-rounded steel point; the diameter of the pointed steel wire should be about  $\frac{1}{16}$  in., which will mark an oval on the copper  $\frac{1}{32}$  in. larger than the zinc plate. This may be more clearly explained by means of the magnified representation in Fig. 14, in which A is a portion of the

\* Some firms supply copper foil ready annealed, which we much prefer  
—AUTHORS.

pointed steel wire, B a portion of the zinc shape, and C D a portion of the copper foil on which the oval is being marked. Many such ovals may be traced on the copper at one sitting,

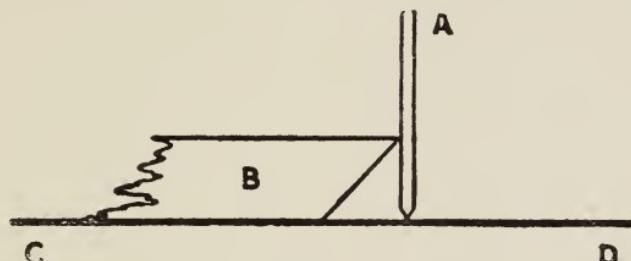


FIG. 14.

and then cut out with scissors. The blades of the little scissors used by Mr. Haddon were but of about one inch in length. In cutting an oval, it is safer to cut a little outside the marked line than to cut inside thereof.

"The copper oval being cut, the next thing to do is to turn up its edge until it forms a very shallow tray. The zinc or brass shape is then placed on the copper oval, so that the copper extends equally all round the shape, the two are held firmly together by means of a screw hand vice, then with a burnisher the edge of the copper is pressed over the edge of the shape, as shown in magnified form in Fig. 15, in which

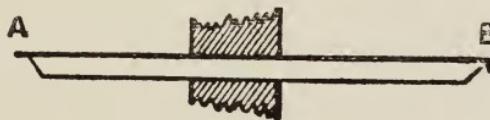


FIG. 15.

the shaded portions represent the jaws of the vice holding the two plates together. A B is the copper plate, turned

down at B by the burnisher, but not at A, the handle of the vice being over A, so that the operator cannot get at the oval there. After the copper has been turned down on one side of the oval, the two plates are turned round and again gripped by the vice, so that the copper can be turned down on the opposite side of the oval. Unless the copper has been thoroughly well annealed, this burnishing down of the edge is rather difficult to do. Should there be a large excess of copper it can be cut down with a scissors and filed. Without the little edge thus made, the enamel would run off, or deformation of the copper support might take place. The little edge should then be filed with an exceedingly finely cut flat file, until the border is of uniform height. He usually

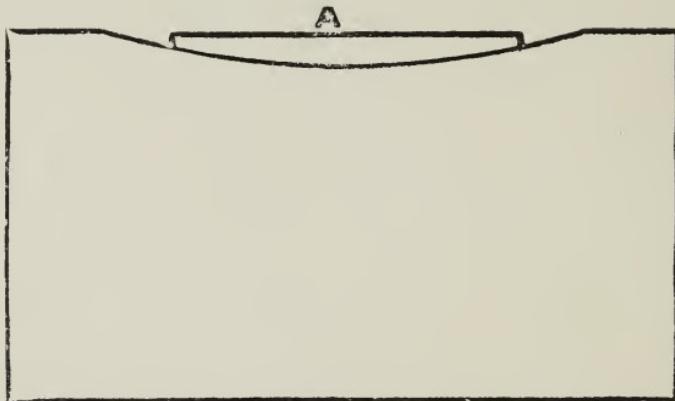


FIG. 16.

filed it upon a piece of boxwood, at a bench near which there was no enamel, for if any of the fine metallic dust found its way into the enamel, spots would be the result in the form of green specks.

"The metal has next to be embossed upon a cavity turned in a piece of hard wood ; this cavity may be circular or oval, according to the shape required, and it must be larger than the copper tray which has to be bent to form therein. Fig. 16 represents the wooden block, with the copper tray turned face downwards over the turned cavity in the block. By pressure with a steel spatula at and about A, the copper tray is bent in until it fits the hollow in the wood, the result of which is a plaque of the section approximately shown in Fig. 17, and almost ready for coating with enamel. In this

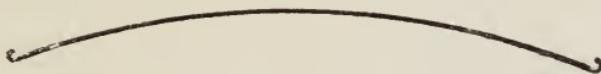


FIG. 17.

operation the plaque gets more or less bent, so that when laid with its edge upon a flat table it will touch the table, but at three points instead of all round the edge ; while, however, upon the flat surface, it can easily be bent right by the aid of a spatula.

"The plaque has next to be 'pickled' to remove oxide. This is done in a 20 per cent. mixture of sulphuric acid, with water ; this clearing had better continue for three hours, and until shortly before the copper is covered with enamel. If the plaque is wanted at once it should not be pickled cold, but the diluted acid in which it is placed should be raised to the boiling point for one minute, after which it is washed in cold water, then wiped dry with a clean rag. If not to be

used at once, it should be placed in perfectly dry sawdust ; there is then nothing to do but to brush off the dust before use.

" The excess of water is now poured off the enamel in the two vessels ; the little copper tray is placed with its concave surface upwards on some concave support, and then the application of the enamel begins. The enamel is in two grades, coarse and fine, and ought to be applied with a hog's-hair brush. The enamel must be so far deprived of water as to be creamy ; if it is too thick it cannot be spread properly. A little enamel may be put on the copper surface and then rubbed over it with a finger, then with the brush the proper quantity can be spread over pretty uniformly ; this is assisted by putting the copper tray on a wooden support, and gently tapping the latter upon the table. The washed fine enamel powder has to be put on the concave surface of the copper, not the coarse enamel.

" The water in the enamel has next to be got rid of. At first he used nothing but blotting-paper for the purpose, but he preferred a few folds of old linen upon a tray ; with the copper oval and its wet enamel placed between the folds, at once a large portion of moisture is absorbed, and in time the bulk of the free water is taken up. When nearly dry, and not too dry or too wet, the enamel must be more finely spread by means of a highly-burnished spatula ; unless the enamel be in the proper hygroscopic state, it is not possible thus to spread it uniformly.

"The backs having been thus coated, it is now necessary to coat the fronts. A small quantity of the washed coarse enamel is spread over the surface, and then brought down to the rounded turned-up edge of the copper. It is difficult to spread it when charged with too much water, for it then drags under the spatula, and uniformity of surface cannot be obtained, but by tapping it and its supporting wooden block upon the table, the surface of the enamel becomes smooth. The moisture is removed by linen as before, and it is left under linen until it is dry enough to be spread by a spatula. The steel spatula used might have been about six or seven inches in length; its shape is represented in Fig. 18; the curve

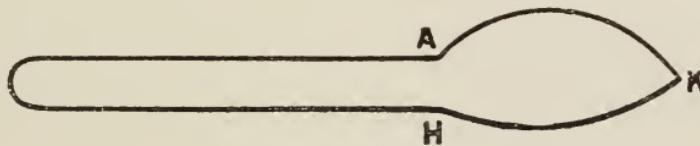


FIG. 18.

of its edge AK had a radius of four inches, and the curve of the edge HK had a radius of five inches.

"Next the whole of the moisture has to be driven off. Where many plaques have to be dried at one time it may be well to provide near the muffle a large cupboard, in which cupboard they can be dried in warm air. He had found it sufficient to place them on a sheet of copper with the small flame of a Bunsen's burner underneath ; after being so treated for ten minutes they are dry enough for firing. When all the moisture has been driven off, the particles of powder on

the upper and lower surface of the copper are simply wedged together, and the slightest touch is liable to make the powder get loose, so the plaques at this stage must be moved only with the greatest care. They have to be placed upon a suitable support for firing; they are sometimes made to rest upon hard earthenware, which will stand the heat. As the enamel might stick to the earthenware, the latter is usually covered with rouge or kaolin.

" When the plaque is inserted in the muffle, the whole is raised to a cherry red heat. Oxide of copper is then thrown off from the exposed edge of the plaque, and precautions have to be taken to prevent this falling on the face of the enamel; the inside of the muffle is therefore, before the firing, smeared with ordinary red lead and water; under the heat, it forms a kind of glaze to which whatever flies to it sticks. The plaque must not be put suddenly into the muffle or the heat may suddenly transform into steam any traces of moisture present, thereby causing the displacement of particles of enamel, for not alone would one plaque be thus destroyed, but some of the others in the muffle on which the freed particles descended. The plaque, having been introduced gently into the muffle, gradually acquires a surface like a ploughed field; this is due to incipient fusion; next there is a gradual coalescence until the surface is smooth. Should the temperature not be sufficiently high the surface will become mottled. If the heat be allowed to act much longer than is absolutely necessary,

green coloration begins, due to silicate of copper extending over the enamel. In the muffle the plaque may be turned round upon its support by means of a long piece of thin steel wire, in order to get its different portions in turn over the hottest part ; the wire should be long, and it should have a wooden handle for the sake of comfort, the heat being great. In some cases, undulations which can be removed will be found on the finished plaque ; in such cases it is necessary to take some powdered flagstone wherewith to grind down the surface by the aid of a piece of wood ; the powder should be mixed with water, the plaque should rest upon several thicknesses of calico, and the grinding should be continued until the whole surface is mat. Specks should then be removed and the plaque re-fired. Lead does not answer for this grinding so well as wood. By rubbing the surface with a piece of pumice-stone, the flagstone powder is removed.

"After the firing, any specks on the enamel have to be removed. This is done by means of a length of square steel, measuring one-tenth of an inch on each side, filed down at the end to a pyramid. The specks must not be removed by digging into the enamel ; the tool is held nearly parallel to the surface of the plaque, and the surface of the enamel at the place of the defect is scraped horizontally. Plaque makers thus remove the enamel right down to the copper, without removing any of the copper itself ; the holes thus

made are filled up with fresh enamel, by means of a spatula made of copper wire, and the plaque is re-fired.

"The plaque next has to be pickled once more, to remove the film of oxide of copper round the naked edge; this pickling is done in a cold twenty per cent. mixture of sulphuric acid and water."

Hitherto there have been no standard sizes of plaques;

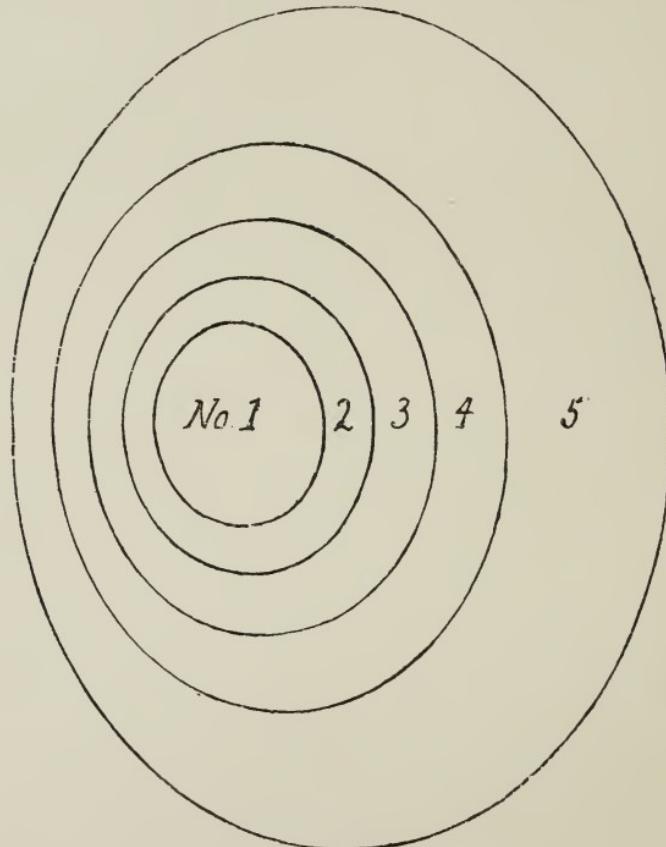


FIG. 19.—Standard Size Oval Plaques

each maker made a different series

We have conferred with several manufacturers and users of plaques and metallic mounts, and in order to reduce the

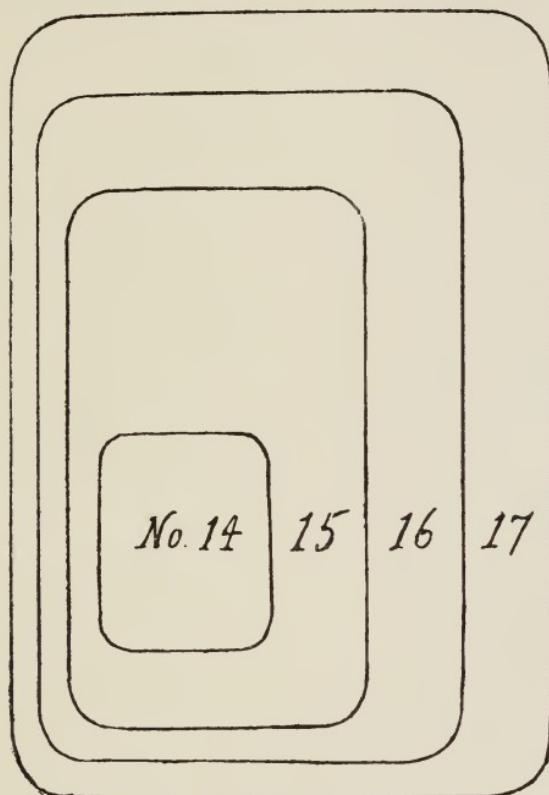


FIG. 20.—Standard Size Rectangular Plaques.

difficulty of securing plaques and mounts adapted to each other we have agreed upon the following sizes as "stock." These will be obtainable of most dealers in ceramic goods. The sizes of ovals are as follows:—

*Ovals.*

NO.	SIZE.	NO.	SIZE.
1 . . .	22×18 m.m.	4 . . .	60×48 m.m.
2 . . .	32×25 m.m.	5 . . .	90×71 m.m.
3 . . .	45×36 m.m.	6 . . .	110×87 m.m.

By the courtesy of Penrose & Co., the English manufacturers of first quality plaques, we are enabled to give diagrams of the actual standard oval and rectangular sizes

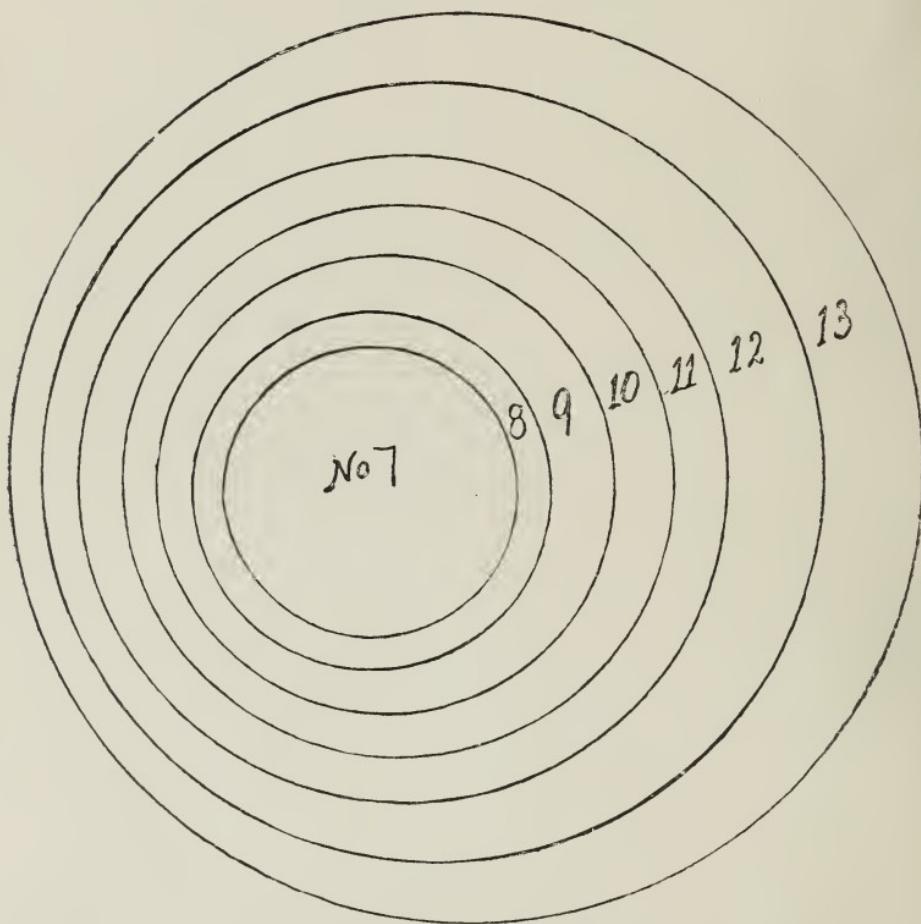


FIG. 21.—Standard Size Circular Plaques.

(Figs. 19 and 20); by means of these diagrams, workers can ascertain at once the size best suited to their purpose.

Circular plaques (Fig. 21) will also be supplied in several sizes by the same firm.

## CHAPTER XII.

## OUTLINE OF THE SUBSTITUTION PROCESS.

In the foregoing chapters we have dealt with the dusting-on process. The substitution process, which was first worked out by Mr. Watson, of Hull, has its supporters, and has been commercially worked by well-known men. Beyond mere experimental work we have not yet touched it, for though in capable hands it yields results second to none, we consider that the intricacies of manipulation at present prevent its general commercial application.

The following particulars must not, therefore, be considered as the result of extensive research on our own part, but as merely given for the information of those who desire an outline knowledge of the process. Mr. N. K. Cherrill took up this work some years ago and modified it somewhat. A report on his method of working, which was published in the *Photographic News Year Book* for 1883—from which we quote at length—goes into such minute detail that a careful worker cannot well go wrong. Mr. Cherrill must, however, have found the work difficult, for in a recent letter read at the London and Provincial Photographic Society his advice to would-be workers resembled that classic warning to those matrimonially inclined.

A piece of well-cleaned glass is coated three times with collodion, and sensitized in a slightly acid bath. Exposure by a soft diffused light is advised.

The development is a most essential point, upon which success or failure frequently hinges, and only by very careful and intelligent work can the best transparency be obtained.

The developer recommended is:—

Pyro	...	...	...	...	12 grains.
Glacial acetic acid	...	...	...	4 drams.	
Alcohol	...	...	...	4	„
Water	...	...	...	12 ozs.	

In his instructions, Mr. Cherrill says:—“ This should be made three days before it is used, as it is too vigorous in its action at the first. On the other hand, it must not be kept too long, as then it deteriorates in the other direction. These are the characteristics in development which, according to my experience, must be obtained in order to secure a good result. The image must develop very slowly. The image must attain the exact density required at the same moment that it attains the right amount of detail in the high lights. The image, when examined by reflected light, must not be ‘filled up’ (if I may use such a term) in the dark parts, or at least the ‘filling up’ must only extend to a very few tones, and above the very darkest. The image, when examined by reflected light, should show, in fact, nearly all the drawing and shading of the subject; while, of course, when seen by transmitted light, it should

show up with extreme perfection. Every detail must be there, with a fair amount of density; but heavy blacks are to be avoided."

After fixing with potassium cyanide, and washing very thoroughly, the film should be floated from the glass support. This will require some little care and patience; careful coaxing with a soft sable brush all round the edge will expedite matters by allowing the water to attack at all points. As soon as the film is thoroughly loose, remove the glass; the film can then be left in the water for some time with safety.

For toning make a saturated solution of potassio-chloride of iridium—about one dram to ten ounces. The bottle must be placed in a pan of water and heated over the fire. A thick wad of paper under the bottle will keep it from direct contact with the pan and so prevent the glass cracking. Thoroughly shake the bottle occasionally, and after three-quarters of an hour's heating remove it from the water and let it cool gradually. This stock solution will keep indefinitely.

For use take —

Stock solution	...	...	...	1 oz.
Chloride of gold	...	...	...	4 grains.
Water	...	...	...	6 ozs.

Shake thoroughly.

To use the enamel toning bath proceed as follows:—Pour

some out into a clean dish to the depth of about half an inch; stand near to this a large dish filled to the depth of one inch with clean water, and also a small dish with pieces of glass in it under water; the glasses may be about quarter-plate size, or such as will be found most convenient. Now take up one of these glasses; and slip it under the film containing a transparency to be toned, gently raise the glass to the surface (at the same time manipulating the film with a camel's-hair brush, held in the right hand) in such a manner that, when the glass and film on it are lifted out of the water, there will be an edge of film, say a quarter of an inch wide, lapping over one edge of the glass. The action of the water, as the plate is taken out, will wash this piece of edge of film round to the back of the plate, and, by so doing, will fix the transparency on the glass in a very satisfactory manner. If care be taken that the edge where the film laps over is kept uppermost, or highest, a very considerable stream of water may be poured on the film without any danger of it slipping. Having got the film on the glass, it should be rinsed under the tap in the manner just suggested, and the film may then be immediately transferred to the toning bath. To do this turn the glass over so that the body of the film is underneath, lower it gently, under the surface of the solution, and, with a brush, disengage the lap of film where it had turned the edge of the plate, now, of course, uppermost. As soon as

this is done the film will move off into the solution free of the glass, which can then be removed. When the film has floated free for about a minute, turn it over with the brush, and note carefully if the deepest shadows are toned through, so as to give one uniform tint to the whole film. Turn the film over and over, and move it about till this is effected, and, as soon as it is so, remove it from the bath by the same piece of glass, used in the same manner, *i.e.*, securing the film by making a little piece of it lap over to the back along one edge of the glass. Let the film drain a few moments and then transfer it to the large dish of clean water. As soon as it is free of the glass in this dish gently agitate the water with a brush, so as to wash away the toning solution still adherent to the film.

To the last washing water add a few drops of ammonia; then, after a few seconds' immersion, remove the film to clean water again, ready for floating on to the plaque.

Hold the plaque in the left hand, and gently insert under the film, which may require a little gentle handling with a soft sable to make it spread evenly. Raise it from the water and put to dry in some place free from dust.

The enamel is now ready for firing; at this stage the picture presents a beautiful appearance, and the beginner is not unnaturally prone to think success achieved, and to discount the "many a slip" which may accompany those processes—so unaccountably erratic in the experience of a novice—firing and glazing.

For firing use cherry red, inclining to white. The furnace should be fully heated before firing is commenced, but the plaque should be advanced very gradually to the heat. When the colour of the film begins to change under a gentle roasting, a few inches in front of the muffle, the plaque may safely be placed in the hottest part. The whites of the picture will not show until after the plaque has turned uniformly dark—almost black. As soon as the whites appear remove the plaque to cool. At this stage the plaque appears ruined beyond hope of recovery; the high lights will stand out clearly, but all the half-tones and shadows will be jumbled together in one confused mass.

This is said to be the true characteristic of an enamel produced by the substitution process after its first firing. It is now ready to be glazed.

"About a thimbleful of the glaze (which is a fine powder like flour) is placed in a small, narrow bottle—say a two-ounce medicine bottle—and the bottle filled up about three-fourths with alcohol. This is marked "Glaze in alcohol." To make up the glazing mixture take a two-ounce medicine-bottle and put in it half-an-ounce of uniodized collodion, such as would be used for negatives. Add to this a quarter of an ounce of methylated ether, and half-an-ounce of alcohol. Now add as much water as it will take without throwing the gun-cotton down. To do this set the tap to drip very slowly, and get one drop into the bottle; shake violently, and then get another drop in and repeat the

shaking. So go on till six or eight drops are added, which will be about enough. Shake up the bottle of "Glaze in alcohol" and let it rest about two minutes for the coarser particles to subside, then carefully add some of the upper part of the mixture to the diluted collodion, enough to make it rather opaque and milky-looking will do. This is the glaze ready for use. It must be well shaken up each time it is used.

"When the enamel is quite cold balance it on the top of one finger if small, or near the edge of a piece of flat wood if large, and pour the glaze mixture over it. Then immediately tilt the enamel up to the vertical position, letting the superfluous glaze run on to soft blotting-paper, rocking the tablet in the meantime to prevent the formation of lines. When the collodion is set, place the tablet in a muffle on a piece of fire-clay, and gradually introduce it to the full heat. Keep a careful watch now to see that the firing does not proceed too far. The glaze should only just melt. As soon as this is the case—which will be seen by looking at the reflection of the bent wire held just above the tablet—pull the enamel out, and, when a little cool, remove to a block of wood to get cold again.

"The image is now indelibly fixed, and it may be treated roughly with impunity. The picture is not, however, at its full beauty as yet, as, if all the baths, etc., have been in good order, one glazing will not be sufficient. The whites will be glazed or have a polished appearance, but the darks

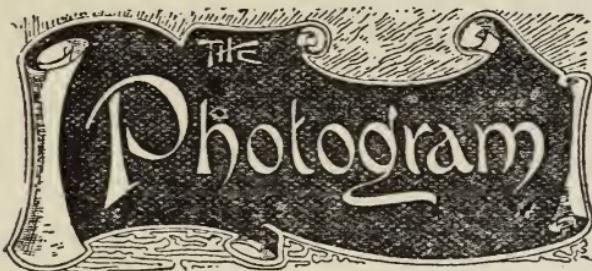
will be still of a matt surface, and not transparent in effect as they should be. This is overcome by repeated glazings.

"No enamel is perfect that has not been glazed at least five times. The number of separate burnings (say five or six) as here recommended give a totally different effect to what would be obtained by one great burn with the glaze applied thicker. Those who wish to save themselves trouble will work in this way, but anyone who wants to get the best results will not mind the trouble of five or six, or even a dozen glazes."

The principal failure to be feared is in applying the glaze.

"The chief thing to avoid in glazing is getting an unequal layer of glaze on the tablet *the first time*. Until the first glaze is burnt in the picture will rub very easily, therefore a badly-laid glaze will be its ruin, as it cannot be removed. After the first glaze is burnt the enamel is safe, and any further error in the matter of pouring on the glaze, etc., can be rectified by simply washing it off again under the tap. Then, again, there is a possibility that, when too much glaze is used, the enamel will spoil by what I have, till recently, looked at as 'burning out,' but which I have since found out to be simply a sinking in of the image. The best remedies for all errors in glazing are to use plenty of alcohol in the collodion, and plenty of water, and at the same time the smallest workable quantity of glaze, making more burns of it, but doing less work at each burn."

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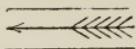
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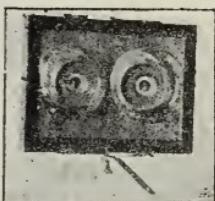
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